Aquatics: Course Outline

I. Natural History of Aquatic Resources in Iowa
   A. Historical Perspective of Iowa's Aquatic Resources
      1. Glaciers
      2. Surface Water
         a. Streams and Rivers
            i. Oxbows
            ii. Backwaters
         b. Natural Lakes
         c. Reservoirs / Constructed Lakes
         d. Surface Mines & Pits
         e. Ponds
         f. Springs
         g. Wetlands / Shallow Lakes
      3. Groundwater
         a. Aquifers

II. Freshwater Ecology
   A. Abiotic Component
   B. Biotic Component
   C. Water Cycle
   D. Surface Water
      1. Lentic
      2. Wetland
      3. Lotic
   E. Groundwater
   F. Identification
      1. Using Dichotomous Keys
      2. Using Field Guides
      3. Animals
      4. Plants
      5. Invasive Species

III. Water Management
   A. Economics
      1. Humans
         a. Water Supply
         b. Wastewater
      2. Recreation
         a. Sustainable Yield
         b. Harvest
      3. Commerce
      4. Industry
   B. Watershed (HUC's)
   C. Agencies
      1. EPA

2. FEMA
3. DNR
4. USCOE
5. USFWS

D. Water Quality
1. Physical
2. Biological
3. Chemical
4. Pollutants
a. Point Source
b. Non-Point Source

E. Classification of Water Resources
1. Class A
2. Class B
3. Class C
4. General Use

F. Sampling Equipment
1. Vertebrates
2. Invertebrates
3. Water Quality (chemical/physical parameters)

IV. Careers Associated with Aquatics
A. Governmental
1. Local
2. State
3. Federal

B. Private

V. Appendix
A. Terms
B. Resources
C. Curriculum Standards
1. Agriculture
2. Science

Aquatic: Terms

acid rain
acre-foot
aerobic
algae
algal bloom
alkaline
anadromous fish
anaerobic
aquaculture
aquatic
aquatic macrophytes
aquifer
bacteria
benthic
benthos
best management practice - BMP
bioaccumulation
biological oxygen demand - BOD
biodegradation
biodegradable
blue-baby syndrome
bog
brackish water
cation
channelization
cohesion
coliform bacteria
community
compensation depth
cone of depression
confined aquifer
contamination
cubic foot per second - CFS
current
denitrification
discharge
dissolved oxygen
dissolved solids
diversion
drainage area
drainage basin
drawdown
ecosystem
effluent
emergent plants
endangered species
environment
ephemeral stream
epilimnion
erosion
Escherichia coli Bacteria (E-coli)
estivation
estuary
eutrophic
eutrophication
evaporation
evapo-transpiration
fecal bacteria
fecal coliform bacteria
fen
fertilizer
filter feeder
filtrate
floating-leaf plant
floodplain
fluvial
freshwater
friable
fry
gaining stream
glacial
glacial drift
ground water
ground water recharge
habitat
hard water
headwaters
herbaceous
herbicide
hydric soil
hydrologic cycle
Hydrologic Unit Code - HUC
hypolimnion
infiltration
impermeability
indicator species
inorganic
insecticide

intermittent stream
intolerant organism
invertebrate
irrigation
Karst
kettle
kettle lake
lacustrine
lagoon
leachate
leaching
lentic
limnetic
limnology
littoral
losing stream
lotic
marsh
meanders
mesophyte
mesotrophic
metalimnion
micocytin
midge
monitoring
nitrate
nonpoint-source pollution
nuisance species
nutrient
nymph
oligatrophic
organic
organic detritus
osmosis
outwash
oxbow
palustrine wetlands
parts per billion - PPB
parts per million - PPM
pathogen
peat
pelagic
perched ground water
percolation
perennial stream
permeability
pesticide
PH
phosphorus
phytoplankton
pioneer plant species
plankton
point-source pollution
pollutant
population
potable water
prairie pothole
precipitation
riffle
riparian
riparian zone
riverine wetland
runoff
saturated zone
secchi disk
sediment
sedimentation
septic systems
sessile
siltation
sinkhole
soft water
solute
solution
solvent
spring
stratification
stratified drift
submersed plant
substrate
summer kill
surface runoff
surface tension
surface water
suspended sediment
sustainable yield
swamp
thermocline
thermal pollution
threatened species
tile drain
till

tolerant species
total maximum daily load - TMDL
transpiration
turbidity
turnover
unconfined aquifer
unsaturated zone
useable water
urban runoff
vascular plant
vernal pool
viscosity
wastewater
watershed
water table
weather
weathering
wetlands
winter kill
withdrawal
xerophyte
zooplankton

Aquatic: Resources

The following resources were suggested by the writers and reviewers. There are many additional resources available and many more being developed daily, especially via the web. Website resources contain lists of publications related to specific topics. Individual books or pamphlets from websites were not listed because of space. Please view these as a starting point and add others to the list as you develop your specific course objectives.

Websites:

Conservation Districts of Iowa

Conservation Districts of Iowa (CDI) is a nonprofit organization devoted to providing educational programs on the conservation of soil, water, and other natural resources. CDI coordinates Iowa's Envirothon program.
http://www.cdiowa.org

Iowa Department of Agriculture and Land Stewardship

Information and publications related to Iowa's Agriculture and Conservation/Natural Resource issues and programs
http://www.agriculture.state.ia.us/default.htm

Iowa Department of Natural Resources

Publications on conservation/natural resources including, Project Learning Tree, Project Wild, Project WILD *Aquatic*, and supplements to these programs which provide background information relative to wildlife and their management.
http://www.iowadnr.gov

Iowa Geological Survey

Responsible for the collection, analysis and dissemination of information on Iowa's rivers, lakes, groundwater, and wetlands.
http://www.igsb.uiowa.edu/

Iowa Lakes Information System

Provides a comprehensive access point for obtaining physical, chemical and biological information for Iowa's lakes
http://limnology.eeob.iastate.edu/lakereport/

Iowa Rivers Information System

Provides a comprehensive access point for obtaining physical, chemical and biological information for Iowa's interior streams and rivers.
http://maps.gis.iastate.edu/iris

IOWATER

Includes information on volunteer water quality monitoring (fact sheets, Benthic Key, Manuals, etc.)
http://www.iowater.net/defaultExp.htm

Iowa State University Extension Publications

Extensive publication list for all aspects of aquatic and fisheries management.
http://www.extension.iastate.edu/pubs

Natural Resources Conservation Service

Extensive publication list for wetland programs.
http://www.nrcs.usda.gov/technical/land/pubs/

U.S. EPA Office of Wetlands, Oceans, and Watersheds

Provides information on Oceans, Watersheds and Wetlands of the United States
http://www.epa.gov/OWOW/

Books, CD's, Pamphlets:

Background Information on Iowa's Aquatic Resources. IDNR, http://www.iowadnr.gov/education/backinfo.html

Biodiversity CD. IDNR, Contains information about Iowa's Aquatic habitats and the types of organisms living in them. order from AquaticEd_Info@dnr.iowa.gov

Field Guides. A variety of field guides, each with their own unique qualities, are available from many sources. It is important to know how to use a Field Guide to identify specimens.

Iowa's Natural Heritage. Iowa Academy of Science and Iowa Natural Heritage Foundation. 1982. Call Iowa Natural Heritage at 1-515-288-1846.

Managing Our Natural Resources. Camp, William G., etal. 2002. DELMAR, 4th ed. http://www.Agriscience.Delmar.com

Putting Together a Watershed Management Plan. CTIC, http://www.ctic.purdue.edu/KYW/Brochures/PutTogether.html

Wildlife & Natural Resource Management. Kevin H. Deal, DELMAR, 1998. http://www.Agriscience.Delmar.com

Aquatics: Curriculum Standards and Benchmarks

Agricultural Education
Standards, Benchmarks, and Performance Indicators

Agricultural Business, Supply & Service

Standard AB-1: Understand problem-solving, analysis, and decision-making in agriculture.

Benchmarks
A. Analyze situation, use problem-solving approach and make appropriate decisions.

1. Compare the advantages and disadvantages of biological, chemical and cultural pest controls.

Standard AB-12: Understand basic technical skills and knowledge in the occupational area of agricultural business, supply and service.

Benchmark
L. Apply technical skills in a hands-on experiential setting in agriculture.

39. Read a soil classification map.

Agricultural Production

Standard AP-10: Understand basic computational and informational technology.

Benchmark
J. Apply computational and informational technologies to analyze and solve mathematical problems.

1. Evaluate and demonstrate use of current technology in land surveying and measuring.
2. Utilize digitized soil surveys to establish a soil sampling method and formulate a nutrient.

Standard AP-12: Understand basic technical skills and knowledge in the occupational area of production agriculture.

Benchmark
K. Apply technical skills in a hands-on experiential setting in agriculture.

4. Analyze the environmental effect that agricultural stewardship may have on surface and ground water, wildlife, soil, air, and people.
19. Explain soil and water conservation practices and their part in federal program compliance.

21. Identify and demonstrate plant growth and reproduction.
22. Identify and select biological and chemical pest controls for agronomic production.
34. Use the survey plat of township, range and section to describe an area.

Horticulture

Standard H-1: Understand problem solving, analysis, and decision-making in agriculture.

Benchmarks
A. Analyze situation, use problem-solving approach and make appropriate decisions.

2. Use observational techniques to identify healthy, quality plants.
3. Interpret data of soil sample analysis.
5. Choose an appropriate plant for a specific location in a home or business.
6. Choose plants of appropriate mature size, shape, texture, and function for a given site.

Standard H-8: Understand the concept of adapting to change in agriculture.

Benchmark
H. Develop strategies to effectively adapt to new situations and rapid changes in agriculture.

3. Identify issues and trends in horticulture concerning environmental and conservation problems.

Standard H-10: Understand basic computational and informational technology.

Benchmark
J. Apply computational and informational technologies to analyze and solve mathematical problems.

1. Measure a tree trunk accurately using a caliper.

Standard H-12: Understand basic technical skills and knowledge in the occupational area of Horticulture.

Benchmark
L. Apply technical skills in a hands-on experiential setting in agriculture.

26. Identify plants using a botanical key.
27. Identify herbaceous and woody ornamental plants by common name.
51. Explain the process of photosynthesis.
52. Explain factors affecting plant growth: light, water, temperature, humidity, nutrients (micro/macro) soils, atmosphere, and pollutants.
55. Explain the system of scientific nomenclature for plants (e.g., families, genus, and species).
65. Explain the principles of integrated pest management.

Natural Resources

Standard NR-1: Understand problem solving, analysis, and decision-making in agriculture.

Benchmark
A. Analyze situation, use problem-solving approach and make appropriate decisions.

1. Assess and implement BMPs (Best Management Practices) related to agriculture drainage wells, erosion control, irrigation of wastewater, irrigation of groundwater, use of storage tanks (i.e., fuels, Anhydrous Ammonia, etc.) and wellhead and source of water protection which improve water quality.
6. Evaluate means of solving local water resource problems.
11. Collecting, understanding, and analyzing samples to assess water quality and analyze findings.

Standard NR-4: Understand the use of entrepreneurial knowledge and skills in agriculture.

Benchmark
D. Use appropriate communication skills in a variety of occupational situations in agriculture.

3. Recognize the importance of technical assistance.

Standard NR-7: Understand the principles of planning.

Benchmark
G. Apply planning strategies in natural resources management.

2. Identify the role geologic resources have in land use planning.
6. Develop plans which incorporate the use of federal, state, and local agriculture programs to sustain resources (i.e., buffer strips).

Standard NR-8: Understand the concept of adapting to change in agriculture.

Benchmark
H. Develop strategies to effectively adapt to new situations and rapid changes in agriculture.

1. Identify contemporary natural resources issues/concerns relating to agriculture.
2. Adapt to environment/situation.

Standard NR-9: Understand global and cultural diversity issues.

Benchmark

I. Demonstrate a working knowledge of the relationship between global/cultural diversity and occupational success in agriculture.

1. Describe global environmental impact.
2. Explain global positioning systems and graphic information systems and understand practice application.

Standard NR-10: Understand basic computational and informational technology.

Benchmark
J. Apply computational and informational technologies to analyze and solve mathematical problems.

1. Estimate water needs for a community and farm operation.
2. Measure and calculate land area, length, and percent slope.

Standard NR-11: Understand the concept of career development and improvement – lifelong learning.

Benchmark
K. Develop strategies to make a successful transition from school to work.

1. Identify a minimum of five (5) environmental and natural resource occupations and explain the job requirements, major activities performed by persons in these occupations and availability by location.
2. Explain the connection between the natural resources occupations, agribusiness, and technology.

Standard NR-12: Understand basic technical skills and knowledge in the occupational area of natural resources.

Benchmark
L. Apply technical skills in a hands-on experiential setting in agriculture.

1. Explain the economic impact of the loss of wildlife, habitat, urban sprawl, and navigation on wildlife resources.
2. Identify the agricultural impact of groundwater resource availability, management, and use.
5. Describe the connections between land use, rural Iowa, and agriculture.
6. Locate a plot of land given a legal description.
8. Explain the impact agriculture, industry, and population centers have on natural resources and the environment.
9. Use soil survey, topography maps, aerial photos, and other natural resources inventories to interpret, compare (limits and potentials), and plan wise land management.
10. Identify federal, state, and local regulations related to soil and water conservation, water quality, forestry, air quality, and wildlife. Explain their applicability to resource management.
20. Describe how Iowa climate and weather is relevant to natural resources and agricultural resource management.

21. Identify techniques for improvement of aquatic habitats.
22. Identify a minimum of ten aquatic plants and ten aquatic animals common to Iowa.
23. Select appropriate conservation practices that will reduce erosion and improve water quality on a farm and urban area.
24. Describe the types of wind and water erosion and determine soil erosion rates and resulting economic and environmental losses to society.
28. Explain the importance of protecting ground and surface water resources.
29. Explain proper stocking and management of farm ponds.
30. Explain current issues involved in natural resource management.
31. Explain harvest management techniques and regulations.
32. Describe current animal waste regulations as they apply to the environment.
33. Explain State and Federal Ag and Natural Resource Management Agencies and their functions.
34. Explain the hydrologic cycle.
35. Identify local sources of ground and surface water contamination and explain techniques for protecting these resources.
36. Identify and incorporate nutrient management practices including spreading lagoon fertilizers, commercial applicator training, composing of manure and animal carcasses, managing wastes from food processing facilities through composting, developing manure management plans, the application of municipal sludge, and the storage, handling, and transfer of chemicals into agricultural plans.

Agricultural Mechanics

Standard AM-12: Understand basic technical skills and knowledge in the occupational area of agricultural mechanics.

Benchmark
L. Apply technical skills in a hands-on experiential setting in agriculture.

26. Identify types of erosion control structures.

Source: Iowa Content Standards and Benchmarks for Agricultural Education, Iowa Department of Education, 1999.

Science Standards

Standard 5: Understands the structure and function of cells and organisms.

Level III
3. Knows the levels of organization in living systems, including cells, tissues, organs, organ systems, whole organisms, ecosystems, and the complementary nature of structure and function at each level

5. Knows that organisms have a great variety of body plans and internal structures that serve specific functions for survival (e.g., digestive structures in vertebrates, invertebrates, unicellular organisms, and plants)

Level IV
3. Understands the processes of photosynthesis and respiration in plants (e.g., chloroplasts in plant cells use energy from sunlight to combine molecules of carbon dioxide and water into complex, energy-rich organic compounds and release oxygen to the environment)

4. Knows how cell functions are regulated through changes in the activity of the functions performed by proteins and through the selective expression of individual genes, and how this regulation allows cells to respond to their environment and to control and coordinate cell growth and division

Standard 6: Understands relationships among organisms and their physical environment.

Level IV
1. Knows how the interrelationships and interdependencies among organisms generate stable ecosystems that fluctuate around a state of rough equilibrium for hundreds or thousands of years (e.g., growth of a population is held in check by environmental factors such as depletion of food or nesting sites, increased loss due to larger numbers of predators or parasites)

2. Knows how the amount of life an environment can support is limited by the availability of matter and energy and the ability of the ecosystem to recycle materials

3. Knows that as matter and energy flow through different levels of organization in living systems and between living systems and the physical environment, chemical elements (e.g., carbon, nitrogen) are recombined in different ways

5. Knows ways in which humans can alter the equilibrium of ecosystems, causing potentially irreversible effects (e.g., human population growth, technology, and consumption; human destruction of habitats through direct harvesting, pollution, and atmospheric changes)

Standard 7: Understands biological evolution and the diversity of life.

Level III

1. Knows basic ideas related to biological evolution (e.g., diversity of species is developed through gradual processes over many generations; biological adaptations, such as changes in structure, behavior, or physiology, allow some species to enhance their reproductive success and survival in a particular environment

3. Understands the concept of extinction and its importance in biological evolution (e.g., when the environment changes, the adaptive characteristics of some species are insufficient to allow their survival; extinction is common; most of the species that have lived on the Earth no longer exist)

5. Knows ways in which living things can be classified (e.g., taxonomic groups of plants, animals, and fungi; groups based on the details of organisms' internal and external features; groups based on functions served within an ecosystem such as producers, consumers, and decomposers)

Level IV

2. Understands the concept of natural selection (e.g., when an environment changes, some inherited characteristics become more or less advantageous or neutral, and chance alone can result in characteristics having no survival or reproductive value; this process results in organisms that are well suited for survival in particular environments)

3. Knows how variation of organisms within a species increases the chance of survival of the species, and how the great diversity of species on Earth increases the chance of survival of life in the event of major global changes

7. Knows how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships (e.g., shared derived characteristics inherited from a common ancestor; degree of kinship estimated from the similarity of DNA sequences)

Standard 12: Understands the nature of scientific inquiry.

Level IV

4. Uses technology (e.g., hand tools, measuring instruments, calculators, computers) and mathematics (e.g., measurement, formulas, charts, graphs) to perform accurate scientific investigations and communications

7. Knows that investigations and public communication among scientists must meet certain criteria in order to result in new knowledge and methods (e.g., arguments must be logical and demonstrate connections between natural phenomena, investigations, and the historical body of scientific knowledge; the methods and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigation)

Standard 13: Understand the scientific enterprise.

Level IV
2. Understands that individuals and teams contribute to science and engineering at different levels of complexity (e.g., an individual may conduct basic field studies; hundreds of people may work together on a major scientific question or technological problem)

3. Understands the ethical traditions associated with the scientific enterprise (e.g., commitment to peer review, truthful reporting about the methods and outcomes of investigations, publication of the results of work) and that scientists who violate these traditions are censored by their peers

5. Understands that science involves different types of work in many different disciplines (e.g., scientists in different disciplines ask different questions, use different methods of investigation, and accept different types of evidence to support their explanations; many scientific investigations require the contributions of individuals from different disciplines; new disciplines of science, such as geophysics and biochemistry, often emerge at the interface of older disciplines)

6. Knows that creativity, imagination, and a good knowledge base are all required in the work of science and engineering

Source: Compendium of K-12 Standards, McREL, 2004.
http://www.mcrel.org/compendium/SubjectTopics.asp?SubjectID=2